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Bio 10: 10.1 Cell Growth, Division, and Reproduction

Lesson Objectives

- Explain the problems that growth causes for cells.
- Compare asexual and sexual reproduction.

Lesson Summary

Limits to Cell Size There are two main reasons why cells divide:

- Information "overload": The larger a cell gets, the more demands it places on its DNA. Eventually, the cell's DNA cannot meet the cell's needs.
- Exchange of materials: Cells take in nutrients and eliminate wastes through the cell membrane.
  - The larger a cell's volume, the more materials it needs to function and the more waste it creates.
  - A cell's volume increases at a faster rate than its surface area. As a cell grows, its surface-area-to-volume ratio becomes too small.
  - The larger a cell gets, the harder it is for enough materials to move across its cell membrane.
- **Cell division** solves the information overload and materials exchange problems.

Cell Division and Reproduction Cell division is part of both types of reproduction:

- **Asexual reproduction:**
  - produces genetically identical organisms.
  - occurs in many single-celled organisms and in some multicellular organisms.
  - allows rapid reproduction of organisms in favorable environments.
- **Sexual Reproduction:**
  - produces organisms with genetic information from both parents.
  - occurs in most animals and plants and in many single-celled organisms.
  - increases genetic diversity, which aids species survival in changing environments.

Limits to Cell Size

For Questions 1–4, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ **1.** As a cell's size increases, its amount of DNA <u>also increases</u>.

_____ **2.** The amount of activity in a cell is related to its <u>volume</u>.

_____ **3.** The smaller the cell, the <u>smaller</u> its ratio of surface area to volume.

_____ **4.** The <u>information crisis</u> in a cell is solved by the replication of the DNA before cell division.

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5. **VISUAL ANALOGY** In the visual analogy of the growing town, what does the library represent? Identify two characteristics that make it a good choice for this analogy.

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Cell Division and Reproduction

For Questions 6–8, complete each statement by writing the correct word or words.

6. _____ is the formation of new individuals.

7. For single-celled organisms, cell division is a form of _____ reproduction.

8. Most multicellular organisms reproduce by _____ reproduction.

9. Use the table to compare and contrast asexual and sexual reproduction.

Asexual and Sexual Reproduction	
Similarities	**Differences**

Apply the Big idea

10. Vascular tissue helps plants transport water against the force of gravity. Because of this, plants that lack vascular tissue do not grow very tall. How is this situation similar to the information you have learned in this lesson? Explain.

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10.2 The Process of Cell Division

Lesson Objectives

- Describe the role of chromosomes in cell division.
- Name the main events of the cell cycle.
- Describe what happens during the four phases of mitosis.
- Describe the process of cytokinesis.

Lesson Summary

Chromosomes Packages of DNA called **chromosomes** hold a cell's genetic information.

- Prokaryotic chromosomes consist of a single, circular strand of DNA.
- Eukaryotic chromosomes are highly organized structures.
  - The DNA winds around histone proteins, forming **chromatin.**
  - Chromosomes make the precise separation of DNA possible during cell division.

The Cell Cycle The **cell cycle** is the series of events in the growth and division of a cell.

- In the prokaryotic cell cycle, the cell grows, duplicates its DNA, and divides by pinching in the cell membrane.
- The eukaryotic cell cycle has four stages (the first three of which are referred to as **interphase**):
  - In the G_1 phase, the cell grows.
  - In the S phase, the cell replicates its DNA.
  - In the G_2 phase, the cell produces organelles and materials for division.
  - In the M phase, the cell divides in two stages—**mitosis**, the division of the nucleus, and **cytokinesis**, the division of the cytoplasm.

Mitosis The division of the nucleus, mitosis, occurs in four stages:

- **Prophase :** a cell's genetic material condenses, a spindle starts to form, and the nuclear envelope breaks down.
- **Metaphase :** the duplicated chromosomes line up and spindle fibers connect to the **centromeres**.
- **Anaphase :** sister **chromatids** separate and move toward the **centrioles**.
- **Telophase :** the chromosomes begin to unwind and a nuclear envelope reforms.

Cytokinesis Division of the cytoplasm differs in plant cells and animal cells.

- In animal cells, the cell membrane draws in and pinches off.
- In plant cells, a cell plate forms, followed by a new cell membrane, and finally a new cell wall forms.

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Chromosomes

For Questions 1–5, complete each statement by writing the correct word or words.

1. Cells carry genetic information in packages of DNA called _____.

2. Most _____ have only one circular strand of DNA.

3. In eukaryotic cells, the genetic structure consists of DNA and a tightly wound protein, which together form a substance called _____.

4. The beadlike structures formed by DNA wrapped around _____ molecules are called nucleosomes.

5. _____ make possible the precise separation of DNA during cell division.

The Cell Cycle

6. What is the name of the type of cell division that occurs in the prokaryotic cell cycle?

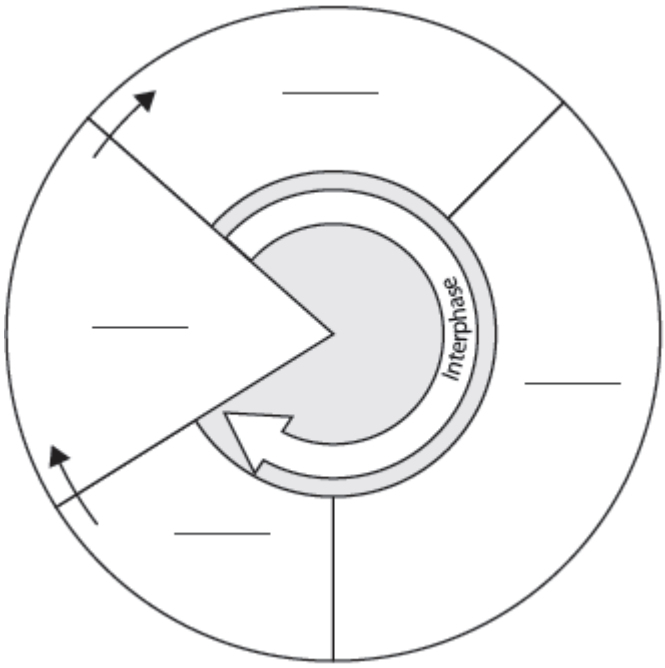
_____

7. What happens during interphase?

_____

_____

8. Complete the cell cycle diagram by writing the correct name of a phase on each line.



9. In eukaryotic cells, what happens in the G_1 phase that differs from the G_2 phase?

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10. In eukaryotic cells, what are the two main stages of cell division?

_____

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Mitosis

11. During prophase, when cell chromosomes become visible, what are the duplicated strands of DNA called? What is the name for the area in which these duplicated strands are joined?

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12. What structures are spindle fibers attached to that help pull the paired chromosomes apart?

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For Questions 13–16, match the description of the event with the phase of mitosis in which it occurs. Each phase may be used more than once.

Event

_____ **13.** The chromosomes separate and begin to move to opposite sides of the cell.

_____ **14.** The chromosomes become visible. The centrioles take up positions on opposite sides of the nucleus.

_____ **15.** A nuclear envelope re-forms around each cluster of chromosomes. The nucleolus becomes visible in each daughter nucleus.

_____ **16.** The chromosomes line up across the center of the cell.

Phase of Mitosis

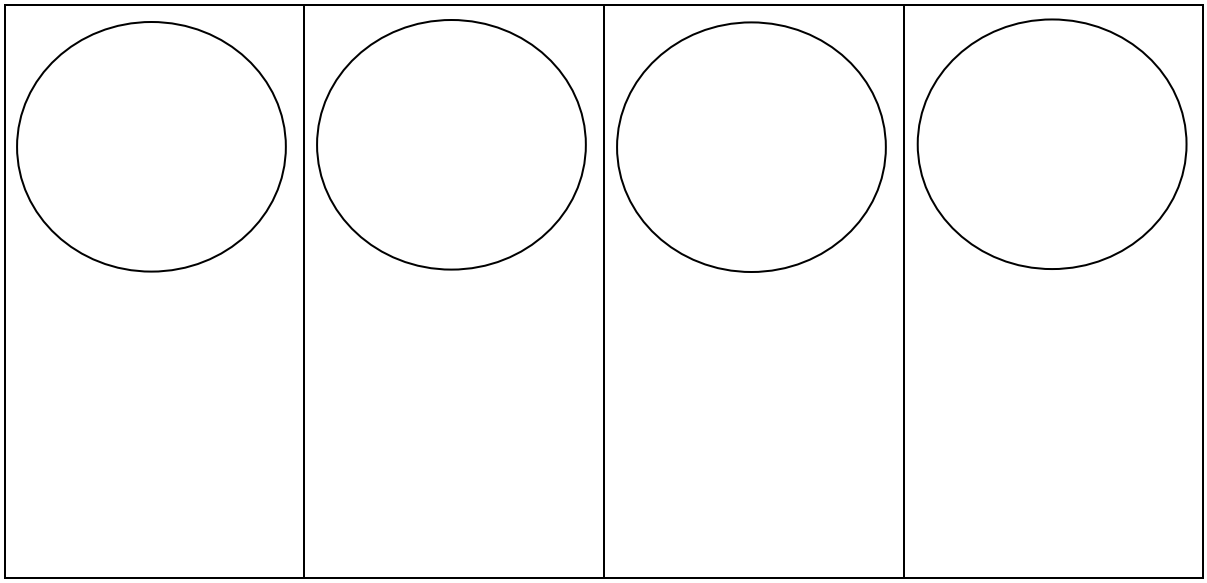
A. Telophase

B. Prophase

C. Metaphase

D. Anaphase

17. **THINK VISUALLY** The four circles below represent the nucleus of a cell going through mitosis. Draw four chromosomes as they go through each phase. Label each phase and describe what is happening to the DNA.



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Cytokinesis

18. What is cytokinesis?

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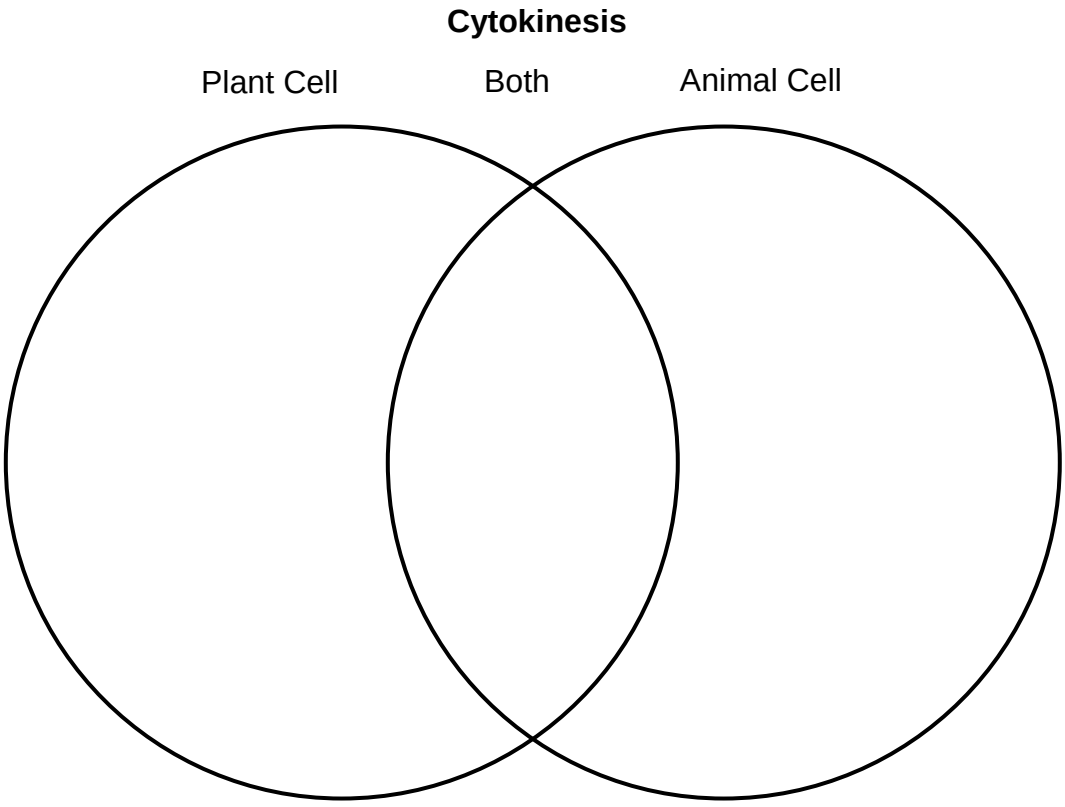
19. Use the Venn diagram to compare and contrast cytokinesis in animal cells with cytokinesis in plant cells.



Apply the Big idea

20. During certain stages of their life cycle, some cells repeatedly undergo mitosis but do not undergo cytokinesis. What would you expect to see if you looked at such cells, or a tissue made up of such cells, under a microscope? Explain your answer.

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